

THE RENAISSANCE, NEW SCIENCES, AND RELIGIOUS WARS IN EUROPE

Part I

THE RENAISSANCE

- End of the 14th century
 - Decline of feudalism → new political, social entities
 - Achievements of Middle Ages pushed Western civilization in new direction
 - Creation of Western monarchies
 - Development of English law, Parliament
 - Foundation of universities
 - Vernacular works of literature
 - Revival of commerce
- Rise of the nation-states
- Universal access to commerce, capital

THE RENAISSANCE

- Change in intellectual pursuits
 - Education → more widely available
 - Movement away from Scholasticism to ancient Latin, Greek classics
- Familiarity with texts = desire to return to Greco-Roman civilization
 - Re-awaken sense of human beauty, appreciate man's achievements
- Period given the name "Renaissance" by 19th century French historian
 - "Rebirth"
 - Misnomer
 - Preceded by proto-Renaissance (app. 1300-1400)
 - Renaissance itself only lasted a little over 100 years (1400-1517/1527/1564)

THE RENAISSANCE

- Postclassical period → 500 AD – 1500 AD
- Modern Period → 1500 - Present
 - Early Modern Period → 1500-1789
 - Mid-modern Period → 1789-1914
 - Contemporary Period → 1914-Present
- Early Modern Period encompasses:
 - Renaissance, Age of Exploration, Baroque, Age of Reason, Enlightenment, beginning of French Revolution
 - Renaissance and Baroque ages are characterized largely by art

THE FALL OF CONSTANTINOPLE AND THE RISE OF THE ITALIAN FREE CITIES

- Economic growth of Italian cities → key contribution to Renaissance
 - Italian cities → centers of commerce
 - Formed society based on merchants and commerce → buy and sell freely
 - Growth aided by 70-year papal absence from Rome (Avignon papacy)
- Decentralization in Italy → noble families set up own governments
 - Rise of independence among nobility → petty wars

THE FALL OF CONSTANTINOPLE AND THE RISE OF THE ITALIAN FREE STATES

- As Byzantine Empire declined in the East, center of trade shifted to Italian cities
 - Dramatic increase of goods, merchants → strong business economy
- Growth of free trade, significant increase of scholarship
 - Influx of Greek intellectuals → fleeing instability of Constantinople
- May 29, 1453 → Constantinople falls to the Ottoman Turks

THE FALL OF CONSTANTINOPLE AND THE RISE OF THE ITALIAN FREE STATES

- Italian city-states greatly benefited from decline and fall of Constantinople
 - Shifted trade to Venice, Genoa, Florence
 - Italian ports → greater center of ideas from areas outside of Christendom
 - Unprecedented levels of toleration

THE ITALIAN WORLD OF THE 15TH CENTURY

- Increased urbanization
 - Peasants moving to the cities → trade, sell goods
 - Feudalism had never been as strong in Italy as elsewhere
 - Urbanized populations → relatively independent
 - Independence → acquisition of great wealth among business class

THE ITALIAN WORLD OF THE 15TH CENTURY

- Prosperous city-state → rise of the middle class
 - Involvement of ordinary people in political life
- Education became more vital
 - Demand for less theological, more humanistic curriculum
 - *Studia humanitatis*
 - Emphasis on Classical texts, literature
- Not free, democratic in modern sense but each citizen had great control over his own life
 - Greater independence, individuality led to wider demand for, possibility of education

THE ITALIAN WORLD OF THE 15TH CENTURY

- Italian city-states not nationalistic
 - No strong sense of national identity/unity
 - Local dialects, customs, cuisine, family ties
 - Smaller, independent regions – little in common with each other

THE BIRTH OF HUMANISM AND THE FLOURISHING OF ARTS AND LETTERS



ACADEMIA

- Academic emphasis changed in the new schools of the 15th century
 - Rhetoric
 - Grammar
 - History
 - Less emphasis on theological studies
- Curriculum
 - Studied classical works of Greco-Roman civilization
 - A more secular education than found with Scholasticism

ACADEMIA

- Increased focus on ancient world → rising enthusiasm for ancient literature, art, architecture
 - Revive Rome's culture, civilization
 - Look to antiquity for lessons for contemporary Europe

MAN AND GOD

- Increased emphasis on the individual
 - Man's form, beauty, usefulness in society
- Ancient world → certain fascination with human achievement, individual's ability to shape own destiny
 - Focus on the wonders of man's abilities
 - No longer at the mercy of chance
- Medieval man sought his fortune in the next world while Renaissance man focused more on the here and now

DECLINE OF SCHOLASTICISM

- Underwent steady decline in 14th, 15th centuries
 - Had become extremely formulaic
- Medieval philosophy seen as old, monkish, stagnant
 - Overly intricate subtleties, distinctions, technicalities
- Accused Scholasticism of ignoring most important questions concerning human subject:
 - What am I?
 - What is my final purpose?
 - What ought I do?
 - What should I love?
 - What follows death?

DECLINE OF SCHOLASTICISM

- Attacked and questioned by nominalism
 - Associated with William of Ockham (14th century English theologian, philosopher)
 - Argues that true knowledge pertains to empirical knowledge only, not to metaphysical concepts

HUMANISM

- What is humanism?
 - Certain ambiguity in meaning
 - General mood, intellectual climate which focuses on the richness of the human spirit over the almost exclusive theological focus of the Medieval era
- Writers, thinkers labeled “humanists” very diverse in aims, beliefs
 - Term “humanism” loses precision without clarifying term
- Literary genre → elaborate on different facets of human life
 - Spilled over into fine arts

HUMANISM

- Rebelled at specialized education
 - Did not include the exciting matter of human condition
 - Education should not only offer training, but also the moral purpose of making the individual wiser, more virtuous

HUMANISM AND LEARNING

- Revived study of great ancient Roman authors
 - Virgil
 - Cicero
 - Ovid
 - Seneca
 - Tacitus
 - Catullus
- Increased knowledge of Greek culture → Byzantine refugees
 - Homer
 - Aristotle
 - Plato
 - Thucydides

HUMANISM AND LEARNING

- Called the Greco-Roman works “Bonae litterae (good letters) or *litterae humaniores* (more humane letters)”
 - Texts focus on man’s relation to the world rather than to God, eternal salvation
- Roots of Humanism in the Middle Ages
 - Dante Alighieri (1265-1321) → *The Divine Comedy*
 - *Struck a balance between person’s earthly condition and life after death*
 - Petrarch (1304-1374) → Father of Humanism
 - Much of his fame comes from his poetry (Laura)
 - Boccaccio (1313-1375) → *Decameron*
 - *Collection of one hundred stories told by ten travelers*
 - *Resource for understanding life in the Italian city-states*
 - *Opened the door to a new, secular era of literature, culture*

CULTURAL TRANSFORMATIONS:

Renaissance, Baroque, and New Sciences



THE RENAISSANCE AND BAROQUE ARTS

- Period of cultural transformation
- Renaissance was an outgrowth of scholasticism
 - Broken away from scholastic precepts
- Powerfully influenced by writings of Greco-Roman authors not widely known during previous age

THE RENAISSANCE

- Not a sudden break from the past
 - Gradual
 - Natural progression of thought
- Largely an artistic renaissance, rather than scientific
 - Rising middle class
 - Wealthy merchant and aristocratic classes
 - Increase in leisure time
 - Translated Ancients
- Late 15th century Renaissance → first in a sequence of cultural transformations
 - Rapid succession

THE RENAISSANCE AND BAROQUE ART

- Texts of all the ancients, except Thucydides, were known and read in Western Europe
 - Fallacy that they were “rediscovered” in 15th century
- Term itself – “The Renaissance” is misleading (19th century)
 - Carolingian renaissance (9th century)
 - 12th century renaissance
- Influx of Byzantine scholars from Constantinople in Italy
 - Fleeing instability, collapse of the city
- Humanism was not a unique philosophical development of the Renaissance
 - 12th century renaissance

NEW MANUSCRIPTS AND PRINTING

- Byzantine revival (1261-1453)
 - Vigorous debate – Plato vs. Aristotle
- Complete corpus of Plato's work to Western Europe
 - Eastern Christian scholars → Florence, Rome, Venice
- Translations
 - Hesiod, Homer
 - Greek tragedies, comedies
- Development of new script
- Vellum replaced by paper
 - Less expensive

PHILOLOGY AND POLITICAL THEORY

- Increase in study of Greek, Latin, and Hebrew philology
 - the branch of knowledge that deals with the structure, historical development, and relationships of a language or languages
- Desiderius Erasmus
 - Greek and Latin New Testaments
- Critical textual research → foundations in Renaissance

PHILOLOGY AND POLITICAL THEORY

- Nicolo Machiavelli (1469-1527)
 - One of the founders of modern political thought
 - Spent many years in political arena of warring Italian city-states
 - Bitter experience of exile, betrayal
- *The Prince*
 - Written in reaction to precarious political situation
 - Radical development of classical political ideals of justice, clemency, and magnanimity

PHILOLOGY AND POLITICAL THEORY

- Political thought
 - Not achievable through classical, Christian methods
 - Saw papacy as an obstacle to Italian unity
 - Viewed virtues of mercy, humility, pity as obstacles to political effectiveness
 - “Unifier” needed intuitive strength, valor, indomitable spirit
 - Inspired by Aristotle → political realist
- Political theories do not completely reject classical, Christian virtues
 - Cast them down from preeminent positions
 - “The ends justify the means” as an absolute finds its origins somewhat in Machiavelli’s thought

PHILOLOGY AND POLITICAL THEORY

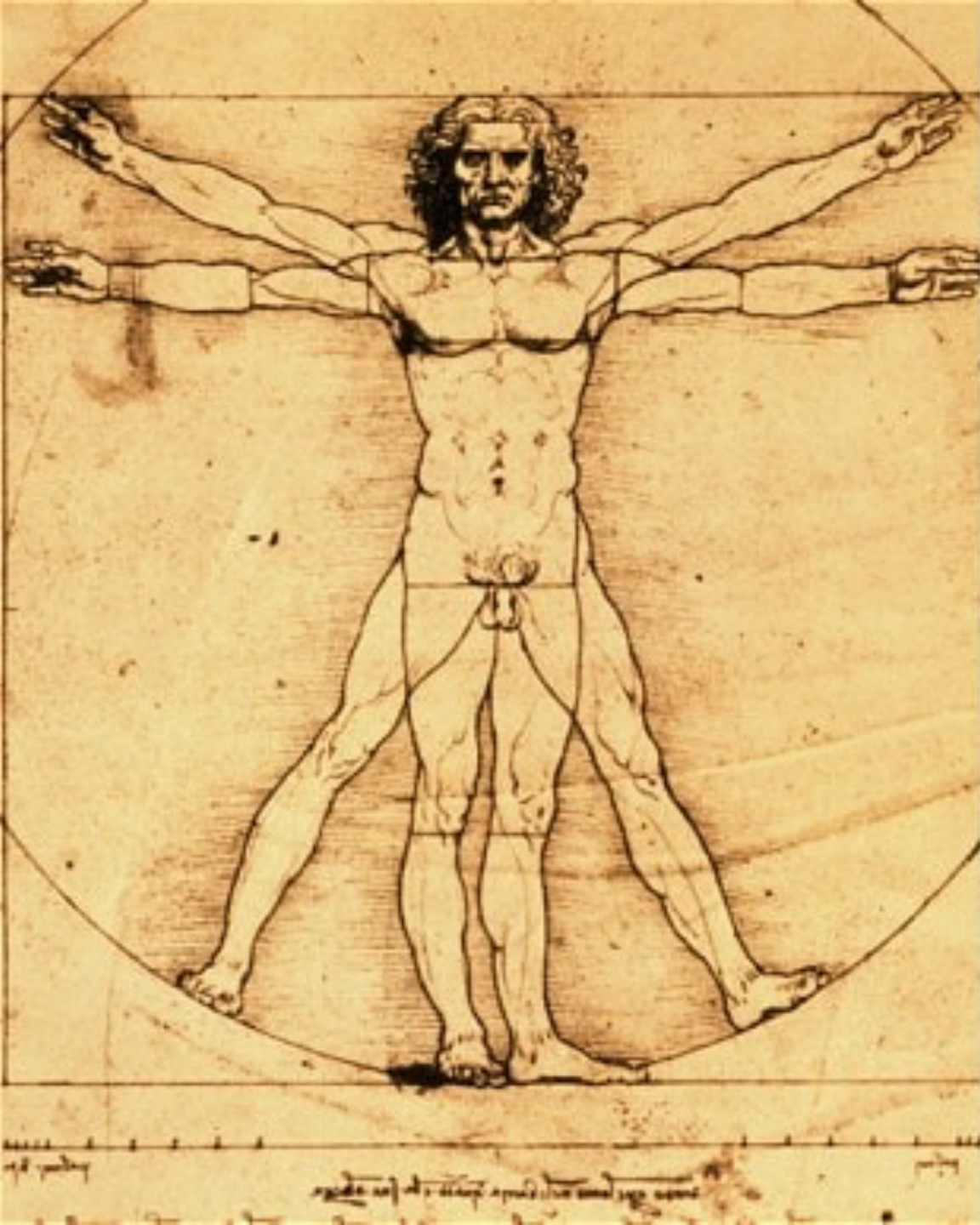
- Machiavelli represented major element of humanist Renaissance writers
 - Focused on secular world
- Growing split between religious and secular life → significant historical development
 - Pagan cultures → gods and spirits everywhere, plan integral part in human existence
 - Ancient Greece and Rome → political, social, economic life was in part dictated by an objective moral law
 - Early Christians → religion dominated everyday life
 - Middle Ages → rise of monasticism, integral to structure of Western civilization

THE RENAISSANCE ARTS

- Especially reflects the new mindset of the 15th and 16th centuries
- Art → considered to be pinnacle of human achievement
 - Human person could display skill, ability in crafting beautiful work exhibited in perfect form, balance, composition
 - Aristocracy → responsible in great part in promoting the arts
- Distinguished Renaissance world from the religiously-centered Medieval period

THE RENAISSANCE ARTS

- New artistic perspective
 - Donatello (1386-1466)
 - Filippo Brunelleschi (1377-1446)
- Inspiration from Roman imperial statues and ruins
- Artistic triumvirate
 - Leonardo da Vinci (1452-1519)
 - Michelangelo Buonarroti (1475-1564) – (Source 17.4)
 - Raphael (1483-1520)







THE RENAISSANCE ARTS

- Musical composers
 - 1st half of the 15th century – Platonists
- Problem – music of Greeks, Romans completely unknown
 - Partial solution – emphasizing relationship between the word (rhetoric) and music
- 16th century
 - Liturgical needs of Catholic, Protestant churches
 - Hymns, Masses, madrigals
 - Giovanni Pierluigi de Palestrina (1525-1594)

THE RENAISSANCE ARTS

- Theater
 - Rooted in Medieval mystery, passion, and morality plays
- Italy (15th century) - *commedia dell'arte*
 - Forbidden love, jealousy, adultery
- England (16th century)
 - Traveling theater troupes became stationary and professional
 - Playwrights sponsored by aristocracy, Elizabethan court – hundreds of scripts
 - William Shakespeare

THE BAROQUE ARTS

- 1600 → Final transition from Renaissance to Baroque
 - Dominated until approximately 1750
- Two factors
 - Protestant Reformation, Catholic Reformation (Council of Trent), religious wars
 - Greater spontaneity and dramatic effect



Renaissance

- ✓ serenity
- ✓ eternal
- ✓ stability
- ✓ horizontals / verticals
- ✓ calm nobility
- ✓ more reserved / distant
- ✓ idealized

Michelangelo, *David*, 1501-4

Baroque

- ✓ emotional intensity
- ✓ a moment in time
- ✓ dynamism
- ✓ diagonals
- ✓ energy / movement
- ✓ involving / close
- ✓ real / not idealized

Bernini *David*, 1623-24



THE BAROQUE ARTS

- Shift in church and palace architecture to baroque voluptuousness
 - Bavarian, Austrian Catholic churches
 - Versailles Palace
 - St. Paul's Cathedral
- Baroque music
 - Church, palace patronage
 - Antonio Vivaldi, Johann Sebastian Bach







THE NEW SCIENCES

- Renaissance was not a period of immense scientific discovery
 - Many historians consider the initial period of the Renaissance to be one of scientific regression
 - Not until late 16th century that significant scientific figures appeared
- The Renaissance was a period of artistic growth rather than scientific advancement
- Rise of superstition during the Renaissance
 - Alchemy
 - Witchcraft
 - Astrology
 - Necromancy

COPERNICUS'S INCIPIENT NEW SCIENCE

- Aristotle – four elements
 - Earth
 - Water
 - Air
 - Fire
- In astronomical terms, our elements formed distinct layers → shaped the world
 - Did not apply in geographical terms
 - “Floating apple”

COPERNICUS'S INCIPIENT NEW SCIENCE

- Ptolemy was well-known by Medieval scholars
 - Discussed by St. Thomas Aquinas
 - Mathematics of Ptolemy supported Aristotelian (geocentric) concept of the universe
- *Geography* by Ptolemy
 - Concept of a globe composed of a single sphere of intermingled earth and water

COPERNICUS'S INCIPIENT NEW SCIENCE

- Geocentric theory
 - Endorsed by Aristotle, given mathematical probability by Ptolemy
 - Prevailing model for 1500 years → made sense according to what was known prior to the invention of the telescope
- Heliocentric theory
 - Aristarchus vs. Aristotle
 - Nicole d'Oresme
 - Bishop Nicholas of Cusa
 - Nicolaus Copernicus

ARISTOTLEIAN-PTOLEMAIC SYNTHESIS

- Geocentric model of the universe
 - Based on what could be observed → empiricism
 - Complex system
 - Numerous epicycles (paths of heavenly bodies)
 - Mathematical model → did not correspond to physical reality of the universe
- Heliocentric model rejected by ancients – why?
 - No Coriolis effects (force that acts on a rotating object)
 - No stellar parallax (shift of any nearby star against background of distant objects)
 - Argument from the winds
 - Argument from the arrow
- All empirical evidence indicated that the earth was at the center of the universe

COPERNICUS

- Nicolaus Copernicus (1473-1543)
 - University of Kraków
 - Graduated with a degree in canon (Catholic Church) law
 - Canon and Secular Dominican
- *Commentariolus* (1514)
 - Brief theoretical description of world's heliocentric mechanism
 - 1533, 1536
 - Strongly opposed by Martin Luther, Philip Melanchthon

COPERNICUS

- *On the Revolution of the Celestial Orbs* (1543)
 - Bishop Giese of Culm
 - Major work on heliocentric theory
 - Listed seven assumptions that supported the theory
 - Dedicated to Pope Paul III
 - Published near the end of his life
- Argued that universe was made of eight spheres
 - Outermost → motionless, fixed stars, sun
 - Planets revolved around sun, each with own sphere
 - Daily revolutions of sun, stars → Earth's rotation on its axis
- Believed that motions of celestial bodies were uniform circular motions
 - Ellipses

COPERNICUS

- Theories seen as a hypothesis for charting movements of the planets
 - Copernicus could offer no concrete proof of his theories
 - Alphonsine Tables → recalculated
 - Based almost entirely on mathematical calculations
- Solved several problems with Ptolemaic model
 - Contained even more epicycles
- Criticisms from ancient Greeks could still not be answered
 - Constant wind?
 - “Arrow” question

COPERNICUS, GALILEO, AND THE 16TH CENTURY

- Heliocentrism
 - Copernicus's work was generally rejected by most scientists
 - Relatively uncontroversial
 - Used by Pope Gregory XIII to reform the calendar in 1582
- Seven competing models
 - Heraclidean – Geo-heliocentric, mercury and Venus circle Sun; everything else circles Earth
 - Ptolemaic – Geocentric, stationary Earth
 - Copernican – Heliocentric, pure circles with lots of epicycles
 - Gilbertian – Geocentric, rotating Earth
 - Tychonic – Geo-heliocentric, Sun and Moon circle the Earth; everything else circles the Sun
 - Ursine – Tychonic, with rotating earth
 - Keplerian – Heliocentric, elliptical orbits

RUNNING AFOUL OF THE CHURCH

- Galileo Galilei
 - Talented mathematician
 - Taught geometry, mechanics, astronomy
- Telescope
 - Hans Lippershay (1608)
 - Galileo increased magnification 30x (1609)
- Discoveries in astronomy
 - Moon is not a perfect sphere
 - Observation of sunspots → rotation of the sun
 - Discovered that Jupiter had at least four satellites (Galilean moons)*
 - Observed phases of Venus → moves around the sun, not the earth*

RUNNING AFOUL OF THE CHURCH

- Galileo discovered Jovian moons on January 7, 1610
- March 26, 1611 → arrived in Rome to publish a book on his discoveries
 - Hosted and entertained by various churchmen, Jesuits
- April 19, 1611 → Cardinal Bellarmine requested confirmation of Galileo's discoveries from Jesuit scientists at the Collegio Romano
 - Jovian moons were confirmed
- April 22, 1611 → Galileo is received by the Pope and is honored for his discoveries
- May 13, 1611 → honored at a banquet by the Jesuits
 - Given an honorary doctorate

POLITICS AND SCIENCE

- 16th century Europe
 - Reformation
 - Thirty Year' War
 - Catholic Counter-Reformation
- Limits of acceptable theology → narrowed
 - Pope Urban VIII, other officials proposed ways to avoid conflicts between science, theology
 - Friar Marin Mersenne → “defend [your] studies on grounds that God is free to place the earth anywhere He likes, and it is the duty of scientists to find out where He had put it”.

RUNNING AFOUL OF THE CHURCH

- Still could not *prove* heliocentrism
 - Could not answer questions that had plagued Ancient Greeks, Copernicus → stellar paralaxes, Coriolus effect, etc.
- Lack of evidence → primary reason majority of astronomers did not accept Copernicus, Galileo
- Tycho Brahe
 - Measurements of star diameters
- Movement into the arena of theology
 - Compatibility with Scripture
 - Independent interpretation of Scripture

RUNNING AFOUL OF THE CHURCH

- 1615 → Galileo's writings on heliocentrism submitted to Roman Inquisition
 - Claimed that Galileo was attempting to reinterpret the Bible (Source 17.5)
 - Debate with Monsignor Francesco Ignoli
 - Focused on physical, mathematical arguments
- 1616 → Commission declared heliocentrism is "foolish and absurd in philosophy"
 - Cardinal Robert Bellarmine
- Galileo is ordered to stop presenting heliocentrism as provable fact
 - "Not to hold, teach, or defend it in any way whatever, either orally or in writing".
 - Could discuss it as a mathematical and philosophic idea → could not advocate its physical truth

RUNNING AFOUL OF THE CHURCH

- Galileo promised not to hold or publish Copernican theory as scientific fact, but only as an unproven theory or hypothesis

CONFLICT OVER COMETS

- Father Orazio Grassi
 - Professor of mathematics at the Collegio Romano
- 1619 → Father Grassi published a pamphlet which discussed the nature of a comet
 - Concluded that the comet was “fiery body which had moved along a segment of a great circle at a constant distance from the earth”
- Galileo disagreed → said they were optical illusions
- War of words between Grassi, Galileo
 - Uncomplimentary remarks/insults re: Jesuits, Collegio Romano alienated the Jesuits, who had been some of his strongest defenders

RUNNING AFOUL OF THE CHURCH

- Pope Urban VIII (reigned 1623-1644)
 - Friend and admirer of Galileo
 - Opposed condemnation of Galileo in 1616
- Asked Galileo to write a book giving pro and con arguments for both Ptolemaic and heliocentric theories
 - Careful not to advocate heliocentrism
 - Pope asked that his (the Pope's) own views on the matter be included

RUNNING AFOUL OF THE CHURCH

- 1632 – *Dialogue Concerning the Two Chief World Systems*
 - Three speakers – two philosophers, one layman
 - Layman – Simplicio (“Simpleton”/“Idiot”)
- Simplicio → presents traditional Aristotelian-Ptolemaic views
 - Put the words of the Pope in this character’s mouth
- Simplicio’s arguments systematically refuted with “unassailable proof” for Copernican theory
 - Made Galileo’s position very clear
- Further alienated Jesuits by attacking one of their astronomers in the book

RUNNING AFOUL OF THE CHURCH

- Seen as a violation of 1616 agreement
 - Taken as an open public challenge
 - Pope infuriated
- 1633 → trial in Rome
 - Focused on whether he had violated the decree issued in 1616
- Found suspect of heresy → continued promotion of unproven heliocentrism, personal interpretation of Scripture
- Galileo retracted his statements
 - Placed under house arrest at his villa in Tuscany
 - Ordered to keep silent on the issue for the rest of his life
 - *Two New Sciences*
- Died nine years later

RUNNING AFOUL OF THE CHURCH

- Why did the Church require a retraction from Galileo?
 - Possibility of alternative theories
 - Upsetting the beliefs of simple people
 - Harm done to attempts at reconciliation with Protestant churches

JOHANNES KEPLER

- Johannes Kepler (1571-1630)
 - German mathematician, astronomer
 - Copernican → improved Copernican theory
 - Lutheran scientist; imperial scientist to Holy Roman Emperor Rudolph II
- *The Cosmographic Mystery* (1596)
 - First published defense of the Copernican system
 - Believed that he had revealed God's geometrical plan for the universe → the universe itself was an image of God
- *A New Astronomy* (1609)
 - Calculated entire orbit of Mars → hit upon the idea of ellipse
 - All planets move in ellipses with the sun at one focus
- Laws of Planetary motion (1609, 1619)
- Father of modern refracting telescopes

RUNNING AFOUL OF THE CHURCH

- A shifting center?
 - 17th century → interest in the New Sciences shifted
 - Lack of powerful church authority, either Catholic or Protestant
- New Scientists in northern Europe → certain liberty
 - Relative intellectual freedom rather than sympathy from religious authorities
- Flourished, especially in England and the Netherlands

SPANISH NATURAL SCIENCES

- Southern European countries → well situated to make substantial scientific contributions
 - Spain
- New colonies
 - Botanists, geographers, ethnographers, physicians, metallurgists
 - Researched new plants, diseases, peoples, mineral resources of the new world
- Accumulated voluminous amount of knowledge
 - Jealously guarded by Habsburgs

ISAAC NEWTON'S MECHANICS

- Isaac Newton (1643-1727)
 - English physicist
 - Brought New Sciences of Copernicus, Galileo, and Kepler to culmination
- Professor at the University of Cambridge
 - Mathematics, optics, astronomy, physics, alchemy, theology
- 1665 – 1667 → developed theories of calculus
 - Gottfried Wilhelm Leibniz (1646-1716)
- *Mathematical Principles of Natural Philosophy* (1687)
 - Updated Galileo's experimental method
 - Proved Kepler's laws of planetary motion mathematically
 - Stated his belief in and rationale for heliocentrism

THE NEW SCIENCES AND THEIR SOCIAL IMPACT

- 17th century scientists → close communication with each other
 - Scientific societies
 - Salons
- Improvements in scientific instruments
 - Telescopes
 - Microscopes
 - Thermometers
 - Barometers
- Experiments
 - Vacuum chambers
 - Cylinders operating with condensing steam

NEW SCIENCE SOCIETIES

- Chartered scientific societies
 - Royal Society of London (1660)
 - Paris Academy of Sciences (1666)
 - Prussia, Russia, Sweden
- Academies
 - Staff of administrators
 - Scientists as fellows
 - Regular discussion meetings
 - Challenged fellows to answer scientific questions
 - Awarded prizes
 - Organized expeditions
 - Published transactions, correspondences, monographs

NEW SCIENCE SOCIETIES

- Amateur scientists
 - Textbook authors, itinerant lecturers
 - Middle-class amateurs
 - Instrument makers
 - Specialized craftspeople
- Meeting places
 - Coffeehouses
 - Urban homes
 - Country estates
 - Provincial schools

NEW SCIENCE SOCIETIES

- Coffeehouses
 - Allowed literate urban public to meet, exchange ideas
 - Coffee preferred non-alcoholic drink before tea was popularized among the upper classes by Queen Catherine of Braganza, wife of King Charles II, after their marriage in 1662
- Lecturers
 - “Newtonianism lite”
 - Subscriptions
 - Public lectures
- Important role of large, scientifically and technically interested public

WOMEN, SOCIAL SALONS, AND THE NEW SCIENCE

- Women → significant part of public interested in science
 - Sophie Brahe (1556-1643)
 - Marie Cunitz (1607-1664)
- Estimates
 - Second half of 17th century → 14% of German astronomers were women
- Practiced science privately
 - Germany, Poland, the Netherlands, France, England

WOMEN, SOCIAL SALONS, AND THE NEW SCIENCE

- Salon
 - Well-furnished, elegant living room of an urban residence
 - Domestic chamber and semipublic meeting space
 - Made female participation possible
- Culture emerged first in Paris after 1580s
 - Places of new information
- Gabrielle-Emilie du Châtelet (1706-1749)
 - Marquise du Châtelet
 - Mother of three
 - Turned to science after raising her children
 - François-Marie Arouet (Voltaire)
 - Translation of *Mathematical Principles* (1759)

DISCOVERY OF THE VACUUM

- Important scientific instruments
 - Telescopes
 - Microscopes
 - Thermometers
- Barometer → crucial instrument
 - Exploration of the properties of the vacuum, condensing steam

DISCOVERY OF THE VACUUM

- Evangelista Torricelli (1608-1647)
 - Laid the groundwork
 - Experimented with mercury-filled glass tubes
- Blaise Pascal (1623-1662)
 - Invented hydraulic press, syringe
 - Mercury barometer experiment → atmospheric pressure
- Vacuum → important step towards mechanical engineering

THE STEAM ENGINE

- Denis Papin (1647-1712)
 - French Huguenot
 - First step from vacuum chamber to steam engine
 - 1690 → constructed a cylinder with a piston
- 1712 → Thomas Newcomen built the first steam engine

DESCARTES' NEW PHILOSOPHY

- René Descartes (1596-1650)
 - French lawyer
 - Served in Dutch and Bavarian courts
 - Shocked by Galileo's conviction, delayed publication of a book on heliocentrism
 - Considered himself a devout Catholic, strong belief in God
 - Father of modern philosophy
- *Meditations on First Philosophy* (1641)
 - Addresses basic foundation of human knowledge
 - Attempt to show compatibility of religion and science

DESCARTES' NEW PHILOSOPHY

- Argument
 - Cannot trust senses to be the foundation of all knowledge
 - Cannot trust mathematics as the foundation of all knowledge
 - *Cognito ergo sum*
- Senses
 - Illusions
 - Dreams
 - "Wax argument"
- Mathematics
 - "Evil demon"
- *Cognito ergo sum*
 - "I think, therefore I am"

DESCARTES' NEW PHILOSOPHY

- From the very fact that one can be deceived, one knows that one exists
 - Can examine thoughts to see if any prove themselves to be undoubtable
- Finds one such thought in his head → a perfect being
 - Says he could not have gotten the idea of a perfect being unless it had been put in his head by a perfect being
- All-loving, all-powerful God would never allow senses to systematically deceive → can generally trust senses because material objects exist
 - Can trust what is seen in a telescope

DESCARTES' NEW PHILOSOPHY

- Man is composed of two radically different substances
 - Material substance → body/senses
 - Immaterial substance → thinking mind
- Mind and body → two profoundly different realms of reality

VARIATIONS ON DESCARTES' NEW PHILOSOPHY

- Radical distinction between body and mind → lively debate
 - Dualism → which was real? Conceptual? More fundamental?
 - Baruch Spinoza, Thomas Hobbes, John Locke
- Baruch Spinoza (1632-1677)
 - Dutch Jewish philosopher of Sephardic Portuguese extraction
 - Worked as a lens grinder
 - Descartes' distinction → understood only in conceptual sense
 - Developed complicated system → integrate Galilean nature with ideas of God, Good, Just
 - Excommunicated by his Jewish community for heresy

VARIATIONS ON DESCARTES' NEW PHILOSOPHY

- Thomas Hobbes (1588-1679)
 - English philosopher
 - Accepted Descartes' distinction → took it farther
 - Body = fundamental reality; mind = dependent function
 - Focused on bodily passions as principal human character trait
- *Leviathan* (1651)
 - Grim picture of mankind
 - "Solitary, poor, nasty, brutish, and short".
 - Believed without the imposition of a strong political structure, people would destroy each other, society would collapse
 - State = unity = absolute authority
 - Social contract

VARIATIONS ON DESCARTES' NEW PHILOSOPHY

- John Locke (1632-1704)
 - English philosopher
 - Held same position on Descartes as Hobbes
 - Same opinion on body, mind
- Social contract
 - Differed from Hobbes
 - Individuals engaged as equals in social contract
 - Human nature governed by reason, tolerance
 - Government → protected their property, established civil society
 - Governed by law
 - Huge influence on the Founding Fathers of the United States

CENTRALIZING STATES AND RELIGIOUS UPHEAVAL



THE RISE OF CENTRALIZED KINGDOMS

- Emergence of states
 - Transition from manorial knights to professional armies
 - Rulers → strengthen power of administrations
- Centralization of power
 - Collect higher taxes → subsidize infantries
 - Curb power of nobility, cities, local institutions

THE DEMOGRAPHIC CURVE

- European population expanded after 1470
 - Reached pre-Black Death levels (1348) around 1550
 - 85 million inhabitants → excluding Ottoman Empire, Habsburg Empire
- Continued to grow until about 1660 (90 million)
 - Entered period of stagnation → little ice age (1550-1750)
- 1650-1750 → period of moderate population growth
 - From 105 million to 140 million
- In 1750, France (28 million) and Russia (21 million) were the most populous
 - Germany, Italy, Poland, England, the Netherlands, Sweden

THE DEMOGRAPHIC CURVE

- Population figures did not reflect countries' political importance
- Overall figures for Europe → Western Christianity had risen to demographic equivalence of India and China

A HERITAGE OF DECENTRALIZATION

- 15th century Western Christian Europe → quilt of numerous independent or autonomous units
 - Centralizing kingdoms of France, England
 - Hanseatic League
 - Teutonic Knights
 - Denmark, Sweden, Norway, Poland-Lithuania, Bohemia, Hungary
 - Principalities of Germany
 - Duchy of Burgundy
 - Switzerland
 - City-states of Italy
- Majority of units competed vigorously with each other

MILITARY AND ADMINISTRATIVE CAPACITIES

- 16th century → some kingdoms turned mercenary troops into standing armies
 - Stationed in star-shaped forts → 15th century Italian innovation
- Sweden introduced the line infantry in mid-17th century
 - Three-deep lines of musketeers
 - Led to regimental system
 - Permanent regiments,; standardized, multi-color uniforms
- Replacement of matchlock musket by French-invented flintlock (1620-1630)
 - More rapid firing time
- 1660-1700 → French introduction of the bayonet
 - Pikemen phased out

MILITARY AND ADMINISTRATIVE CAPACITIES

- By 1750 → larger armies were more uniform in armaments, larger
 - Increased from a few thousand to tens of thousands of soldiers
- Military forces devoured tax money
 - Taxes expanded substantially between 1450 and 1550
- Taxes could not be raised without formal or informal assent of ruling classes, cities
- Taxation limits reached in mid-16th century
 - 200 years → raising money decreased central powers
 - Exception was the Netherlands
- 18th century → deterioration in state finances